



Patent

UNITED STATES PATENT APPLICATION

FOR

METHOD OF FORMING A COMPUTER CASING

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## FIELD OF THE INVENTION

The present invention relates to a method of forming a computer casing.

## BACKGROUND

Rubber molded over plastic has been known for some time. Recently,  
5 translucent plastic pieces having translucent rubber overmoldings have been  
introduced. The combination of translucent plastic and translucent rubber revealed  
a previously unrecognized problem. The rubber and plastic do not form a stable  
interface. The rubber appears to attack the plastic, resulting in cracks and opaque  
patches appearing in the plastic underneath the rubber overmolding. Such cracks  
10 affect the structural integrity of the plastic piece, and the opaque patches are  
aesthetically unpleasing.

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## SUMMARY OF THE INVENTION

The present invention provides a method of forming a rubber-overmolded casing that involves applying a protective barrier to at least a part of a plastic piece that is part of the casing and then molding a rubber layer onto at least the part of the plastic piece over the protective barrier. In one embodiment, a polyurethane coating provides a protective barrier between a polycarbonate plastic piece and a rubber layer that prevents the rubber layer from attacking the underlying polycarbonate plastic piece.

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## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a flowchart illustrating one embodiment of a method according to the present invention.

Figure 2 is a flowchart illustrating another embodiment of a method  
5 according to the present invention.

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## DETAILED DESCRIPTION

The present invention provides a method of protecting a plastic piece from being attacked by a rubber overmolding. The present invention will be described below in connection with the Figures and with certain embodiments. In the following description, specific details are set forth to provide a thorough understanding of the present invention, however, those of ordinary skill in the art will appreciate that the present invention may be practiced without these specific details. In other instances, details of well-known steps, structures and techniques have been omitted to avoid obscuring the present invention.

The present invention provides a protective barrier between a plastic piece and a rubber layer overmolded onto the plastic piece. While the present invention may be applied to any rubber layer overmolded onto any plastic piece, the present invention is particularly useful for translucent plastic pieces with translucent rubber overmoldings. Translucent polycarbonate pieces with translucent rubber overmoldings include computer casings such as those incorporated into iBook<sup>®</sup> portable computers available from Apple Computer, Inc.<sup>®</sup>.

In a typical rubber overmolding process, a plastic piece is first provided. The plastic piece may be formed by injection molding or other methods known in the art for forming plastic pieces. In injection molding, for example, a plastic resin is melted, and the melted plastic is introduced, or injected, into the mold to be formed into a shape determined by the mold. After the plastic piece has been formed, the plastic piece is placed into a second mold. A melted rubber is introduced into the second mold, and a rubber layer molded over at least a part of the plastic piece in a shape determined by the second mold.

Figure 1 illustrates one embodiment of a method according to the present invention. Methods according to present invention begin at step 100 by providing a

plastic piece **110**. The plastic piece, for example, may be a part of a computer casing, or a part of a casing for a computer peripheral, such as a computer keyboard, printer, mouse, scanner, etc.. The plastic piece may be made of a polymer resin, such as a polycarbonate resin, a polycarbonate-polyester co-polymer resin, a co-  
5 polyester resin, or an ABS (acrylonitrile butadiene styrene) resin. In one embodiment, the plastic piece is translucent. The plastic piece is formed before the methods of the present invention begin, and may be formed by injection molding or other techniques known in the art. The plastic piece typically is allowed to cool down and equilibrate to ambient conditions after being formed.

10 A protective barrier is then applied to at least a part of the plastic piece in a step **120**. The protective barrier according to the present invention typically is applied as a liquid by spraying, brushing, rolling, dipping, etc., or by other techniques known in the art, and typically under ambient conditions. As the liquid dries, the protective barrier solidifies on and adheres to at least the part of the plastic  
15 piece. In one embodiment, the protective barrier is a polyurethane coating.

After the protective barrier is applied to at least the part of the plastic piece, a rubber layer is molded onto at least the part of the plastic piece over the protective barrier at step **130**. The rubber layer may be made of a polyester rubber, a polyether rubber, or other type of rubber known in the art. In one embodiment, the rubber  
20 layer is made of a translucent rubber. In another embodiment, where the rubber layer is made of a translucent rubber, the protective barrier is clear, and so not visible after the rubber layer is molded over at least the part of the plastic piece.

Figure 2 illustrates another embodiment of a method according to the present invention in which a polyurethane coating provides the protective barrier. As with  
25 the embodiment described above, the present embodiment begins at **200** by providing a plastic piece at step **210**. In one embodiment, the plastic piece is made of a polycarbonate resin. As described previously, the plastic piece may be formed

by injection molding or other techniques known in the art, and typically is allowed to equilibrate to ambient conditions after being formed.

In this embodiment, at least a part of the plastic piece on which the protective barrier will be applied is cleaned at step 220. Dirt, oils, dust and other contaminants  
5 that may prevent the protective barrier from adhering to the plastic piece are removed in this step. The part of the plastic piece may be cleaned using a solvent, such as isopropyl alcohol, ethanol, methanol, etc., or other type of cleaner.

The plastic piece is dried at step 230 before the protective coating is applied. Drying removes any residual solvent or cleaner from the plastic piece that may  
10 prevent the protective barrier from adhering to the plastic piece. The plastic piece may be dried using compressed air, using heat, such as in an oven, or by other ways known in the art.

After the plastic piece has been cleaned and dried, the protective barrier made of a polyurethane coating is applied to at least the part of the plastic piece at  
15 step 240. Polyurethane coatings may be applied as a liquid solution made up of two components, an isocyanate component and a polyol component. When the two components are combined, they react, and the liquid solution begins to dry, or solidify, into a polyurethane. While the solution is liquid, it can be applied to and coated on at least the part of the plastic piece. The liquid solution on at least the part  
20 of the plastic piece dries and solidifies to form the polyurethane coating.

Typically, the polyol component is added to the isocyanate component. In one embodiment, the isocyanate component and the polyol component are combined in a ratio of between about 45:55 and about 55:45, either by weight or by volume, to form the liquid solution. In another embodiment, the liquid solution is  
25 made up of approximately equal parts, *i.e.*, a ratio of about 50:50, either by weight or by volume, of the isocyanate component and the polyol component.



The polyurethane coating may be applied to at least the part of the plastic piece by spraying, brushing, rolling, dipping, etc., or by other techniques known in the art, and typically is applied under ambient conditions. In one embodiment, the polyurethane coating is applied at a temperature between about 20° and about 30°C.

- 5 In another embodiment, the polyurethane coating is applied under a relative humidity of less than about 80%.

The polyurethane coating typically is made of an aliphatic polyurethane. In one embodiment, the polyurethane coating is made of an elastomeric polyurethane. In another embodiment, the polyurethane coating is clear.

- 10 After being applied to at least the part of the plastic piece, the polyurethane coating is cured, or solidified, **250** before a rubber layer is molded over the polyurethane coating **260**. If the polyurethane coating is not completely cured before the rubber layer is molded over it, it may become dislodged or torn as the melted rubber is introduced into the mold and flowed over it. In one embodiment,
- 15 the polyurethane coating is cured at an elevated temperature higher than the ambient temperature. In another embodiment, the polyurethane coating is cured in an oven at a temperature between about 70°C and about 90°C. In still another embodiment, the polyurethane coating is cured in an oven at progressively higher temperatures. Curing of the polyurethane coating at an elevated temperature
- 20 typically takes between about 20 minutes and about 60 minutes.

- The protective barrier has a thickness sufficient to protect the plastic piece from being attacked by the rubber layer, but is not so thick as to be dislodged from the plastic piece as the rubber is being molded onto the part of the plastic piece. In one embodiment where the protective barrier is a polyurethane coating, the
- 25 polyurethane coating has a thickness of between about 0.01 mm and about 0.03 mm. In another embodiment, the polyurethane coating has a thickness of  $0.02 \pm 0.005$  mm.





The methods of the present invention produce plastic pieces with rubber overmoldings that do not attack the underlying plastic piece. The present invention thus provides rubber overmolded plastic pieces with enhanced stability. Where the plastic piece is made of a translucent polymer resin and the rubber layer made of a translucent rubber, the resulting article of manufacture does not form cracks or opaque patches and the aesthetic appearance of the article is maintained over time.

The methods of the present invention have been described with reference to certain embodiments. Those of ordinary skill in the art will recognize that numerous variations, modifications, and improvements can be made to the embodiments described above. The scope of the present invention is not limited to the above embodiments, but is defined by the claims that follow.

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